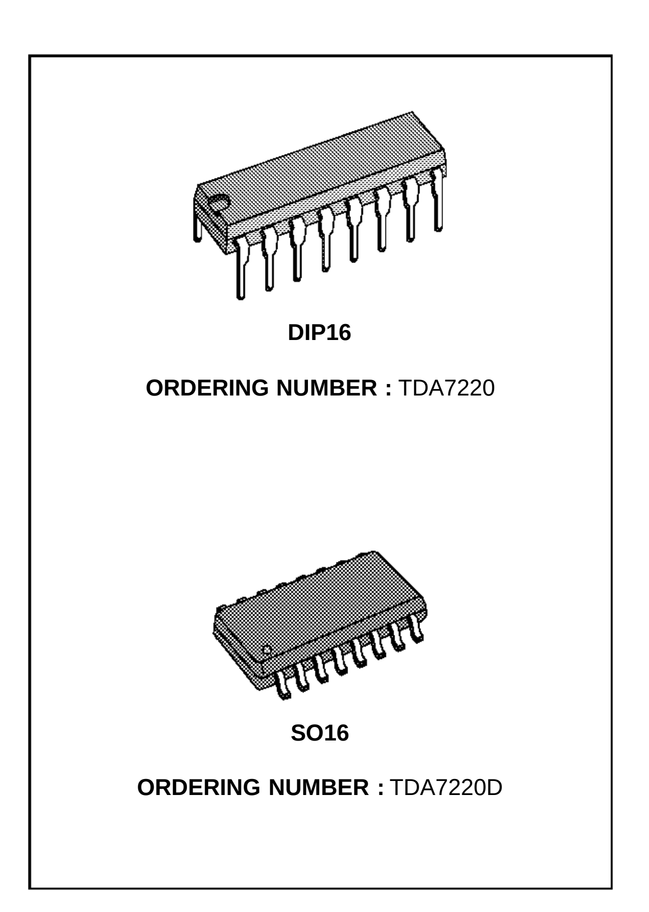




VERY LOW VOLTAGE AM-FM RADIO

- OPERATING SUPPLY VOLTAGE : 1.5 TO 6V
- HIGH SENSITIVITY AND LOW NOISE
- LOW BATTERY DRAIN
- VERY LOW TWEET
- HIGH SIGNAL HANDLING
- VERY SIMPLE DC SWITCHING OF AM-FM
- AM SECTION OPERATES UP TO 30MHz



DESCRIPTION

The TDA 7220 is a monolithic integrated circuit in a 16-lead dual in-line plastic package designed for use in 3V, 4.5V and 6V portable AM-FM radio receivers.

The functions incorporated are :

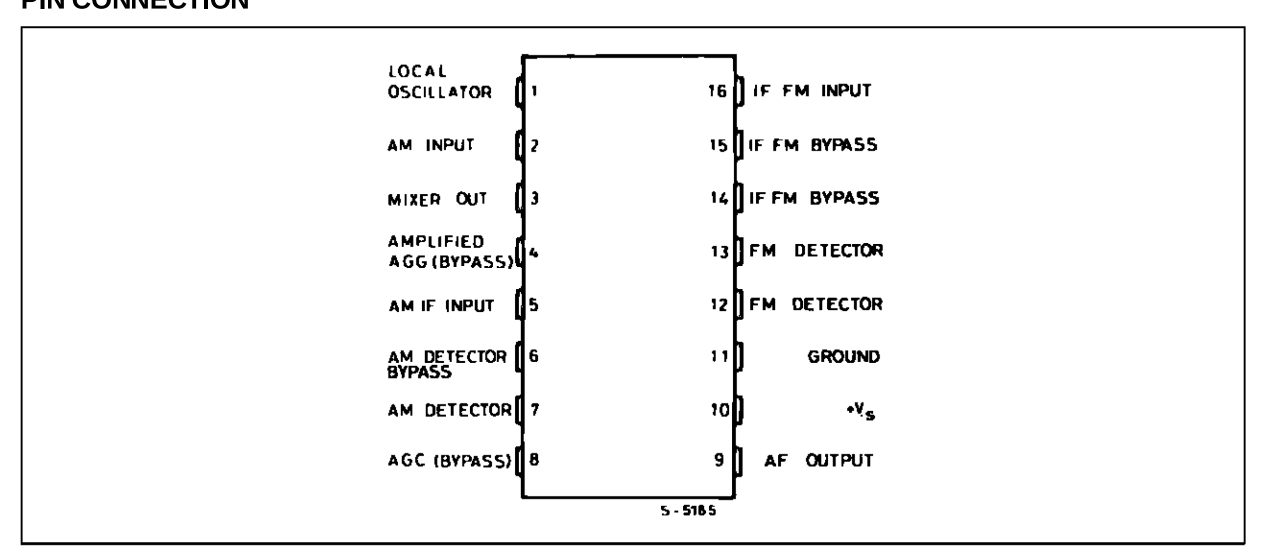
AM Section

- Preamplifier and double balanced mixer with AGC
- On pin local oscillator
- IF amplifier with internal AGC
- Detector and audio preamplifier

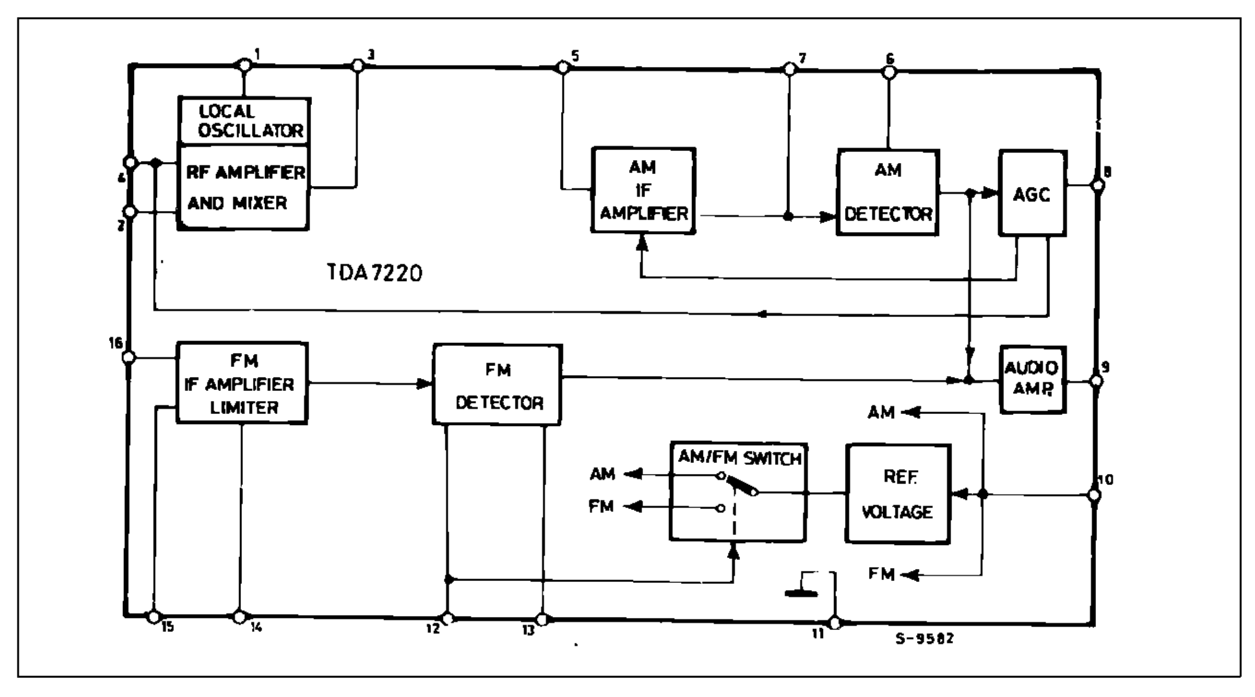
FM SECTION

- IF amplifier and limiter
- Quadrature detector
- Audio preamplifier

PIN CONNECTION



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Supply Voltage	6.5	V
P_{tot}	Total Power Dissipation at T_{amb} < 110°C (DIP16)	400	mW
T_{oper}	Operating Temperature	- 20 to + 85	°C
T_{stg}, T_j	Storage and Junction Temperature	- 55 to +150	°C

THERMAL DATA

Symbol	Parameter		DIP16	SO16	Unit
$R_{th\ (j\text{-}a)}$	Junction-ambient Thermal Resistance	Max.	100	200	°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_S = 3V, unless specified, refer to Test Circuit)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_D	Drain Current	AM Section FM Section		11 10	18 15	mA mA
AM SECTION (f_O = 1MHz, f_m = 1kHz)						
VI	Input Sensitivity	S/N = 26dB, m = 0.3		12	25	µV
S/N	Signal to Noise	V_I = 1mV, m = 0.3	40	50		dB
ΔV_I	AGC Range	ΔV_{OUT} = 10dB, m = 0.8	90			dB
V_O	Recovered Audio Signal (Pin 9)	V_I = 1mV, m = 0.3	40	80	110	mV
d	Distortion			0.6		%
V_H	Max. Input Signal Handling Capability	m = 0.8, d < 10%	0.5			V
R_I	Input Resistance between Pins 2 and 4	m = 0		7.5		kΩ
C_I	Input Capacitance between Pins 2 and 4	m = 0		18		pF
R_O	Output Resistance (Pin 9)			4.5		kΩ
	Tweet 2 IF	V_I = 1mV, m = 0.3		40		dB
	Tweet 3 IF	V_I = 1mV, m = 0.3		55		dB
FM SECTION (f_O = 10.7MHz, f_m = 1kHz)						
V_I	Input Limiting Voltage	- 3dB limiting point		33	80	µV
AMR	Amplitude Modulation Rejection	Δf = ± 22.5kHz, V_I = 3mV, m = 3		40		dB
S/N	Signal to Noise	Δf = ± 22.5kHz, V_I = 1mV	50	65		dB
d	Distortion	Δf = ± 22.5kHz, V_I = 1mV Δf = ± 75kHz		0.3 1.1	 1.5	% %
V_O	Recovered Audio SIgnal (Pin 9)	Δf = ± 22.5kHz, V_I = 1mV	40	70	90	mV
R_I	Input Resistance between Pin 16 and Ground			6.5		kΩ
C_I	Input Capacitance between Pin 16 and Ground			14		pF
R_O	Output Resistance (Pin 9)			4.5		kΩ

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, **V_S = 1.6V**, unless specified, refer to Test Circuit)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_D	Drain Current	AM Section FM Section		8 7	15 13	mA mA

AM SECTION (f_O = 1MHz, f_m = 1kHz)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Input Sensitivity	S/N = 26dB, m = 0.3		15	25	µV
S/N	Signal to Noise	V_I = 1mV, m = 0.3	40	48		dB
ΔV_I	AGC Range	ΔV_{OUT} = 10dB, m = 0.8	90			dB
V_O	Recovered Audio Signal (Pin 9)	V_I = 1mV, m = 0.3	40	75		mV
d	Distortion			0.5		%
V_H	Max. Input Signal Handling Capability	m = 0.8, d < 10%	0.5			V
R_I	Input Resistance between Pins 2 and 4	m = 0		7.5		kΩ
C_I	Input Capacitance between Pins 2 and 4	m = 0		18		pF
R_O	Output Resistance (Pin 9)			4.5		kΩ
	Tweet 2 IF	V_I = 1mV, m = 0.3		40		dB
	Tweet 3 IF			55		dB

FM SECTION (f_O = 10.7MHz, f_m = 1kHz)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Input Limiting Voltage	- 3dB limiting point		50		µV
AMR	Amplitude Modulation Rejection	$\Delta f = \pm$ 22.5kHz, V_I = 3mV, m = 3		34		dB
S/N	Signal to Noise	$\Delta f = \pm$ 22.5kHz, V_I = 1mV		55		dB
d	Distortion	$\Delta f = \pm$ 22.5kHz, V_I = 1mV		0.6		%
V_O	Recovered Audio SIgnal (Pin 9)	$\Delta f = \pm$ 22.5kHz, V_I = 1mV		55		mV
R_I	Input Resistance between Pin 16 and Ground			6.5		kΩ
C_I	Input Capacitance between Pin 16 and Ground			14		pF
R_O	Output Resistance (Pin 9)			4.5		kΩ

Figure 1 : Test Circuit

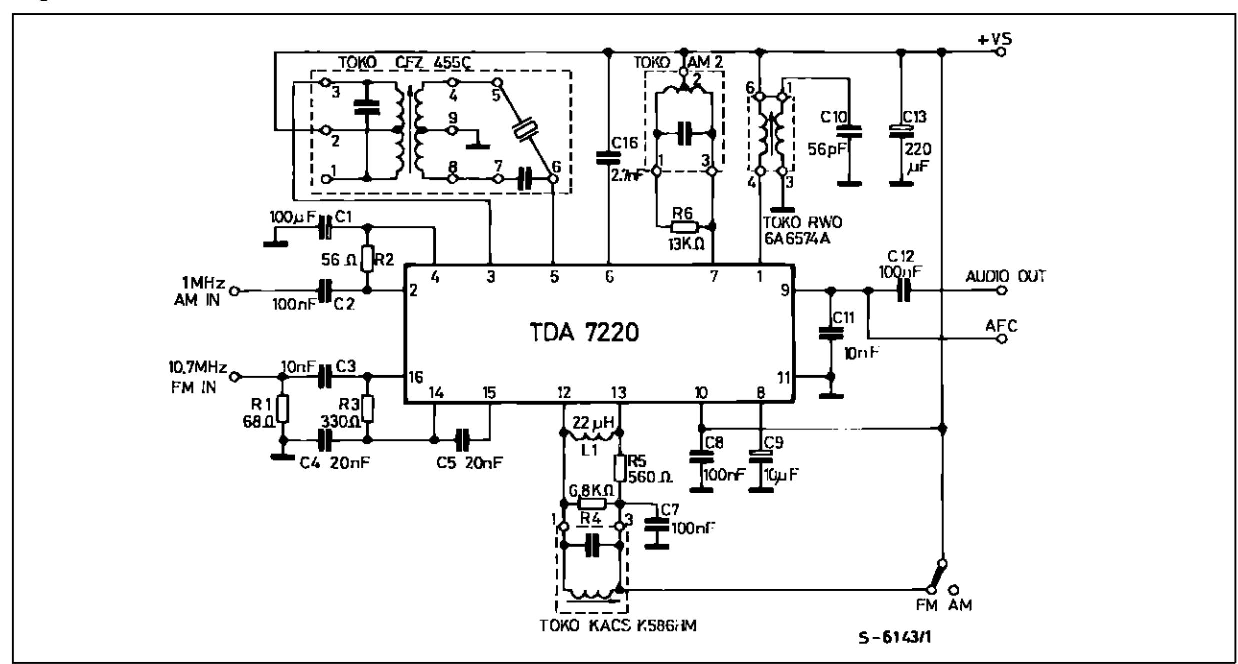


Figure 2 : P.C. Board and Component Layout (1:1 scale) of the Test Circuit

AM-FM SWITCHING

AM-FM switching is achieved by applying a DC voltage at pin 13, to switch the internal reference.

TYPICAL DC VOLTAGE (refer to the test circuit)

Pins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Unit
AM	3	1.1	3	1.1	1.1	2.5	3	0.7	1.2	3	0	2.1	2.1	2.9	3	2.9	V
FM	3	0	3	0	0	2.4	3	0	0.9	3	0	3	3	2.7	2.7	2.7	V

APPLICATION SUGGESTION

Recommended values referred to the test circuit of Figure 1

Part Number	Recommended Value	Purpose	Smaller than Recommended Value	Larger than Recommended Value
C1	100µF	AGC Bypass	Increase of the distortion at low audio frequency	Increase of the AGC time constant
C2 (1)	100nF	AM Input DC Cut		
C3 (1)	10nF	FM Input DC Cut		
C4 C5	20nF 20nF	FM Amplifier Bypass	Reduction of sensitivity	- bandwidth increase - higher noise
C7	100nF	FM detector Decoupling	Danger of RF Irradiation	
C8	100nF	Power Supply Bypass	Noise increase of the audio output	
C9	10µF	AGC Bypass	Increase of the distortion at low audio frequency	Increase of the AGC time constant
C10 (1)	56pF	Tuning of the AM Oscillator at 1455kHz		
C11	10nF	50ms FM De-emphasis		
C12	100nF	Output DC Decoupling	Low audio frequency cut	
C13	220µF	Power Supply Decoupling	Increase of the distortion at low frequency	
C16	2.7nF	AM Detector capacitor	Low suppression of the IF frequency and harmonics	Increase of the audion distortion
R1 (1)	68Ω	FM Input Matching		
R2 (1)	56Ω	AM Input Matching		
R3	330Ω	Ceramic Filter Matching		
R4	6.8kΩ	FM Detector Coil Q Setting	Audio output decrease and lower distortion	Audio output increase and higher distortion
R5	560Ω	FM Detector Load Resistor	Audio output decrease and higher AMR	
R6	13kΩ	AM Detector Coil Q Setting	Lower IF Gain and Lower AGC Range	Higher IF Gain and Lower AGC Range

(1) Only for test circuit.



Figure 3 : Audio Output and Noise versus Input Signal (AM section) V_S = 3V

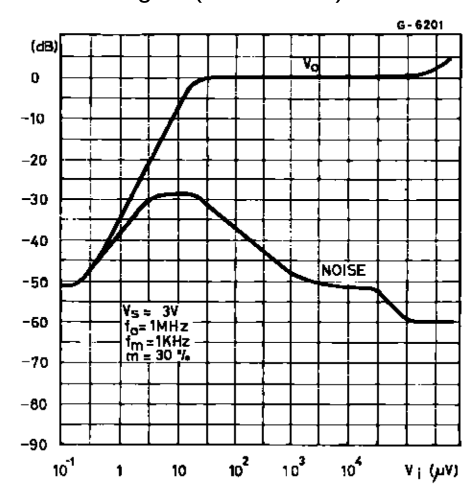


Figure 4 : Audio Output and Noise versus Input Signal (AM section) V_S = 1.6V

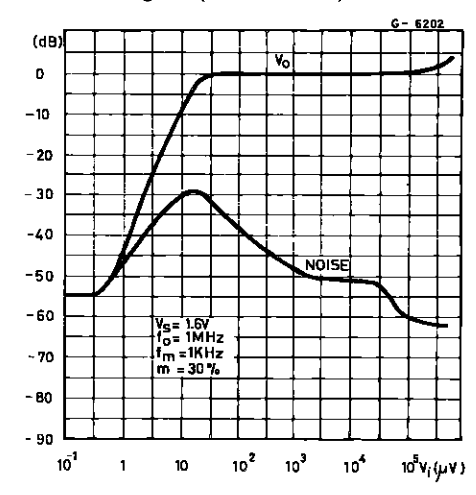


Figure 5 : Distortion versus Input Signal (AM section) V_S = 3V

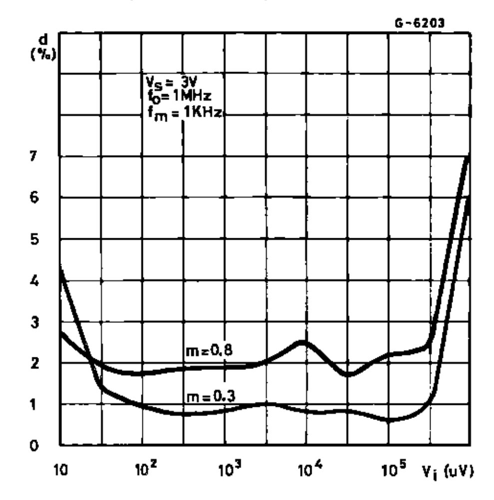


Figure 6 : Distortion versus Input Signal (AM section) V_S = 1.6V

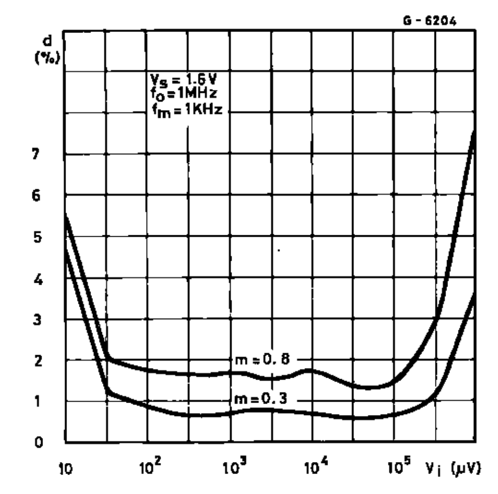


Figure 7 : Audio Output versus Supply Voltage (AM section)

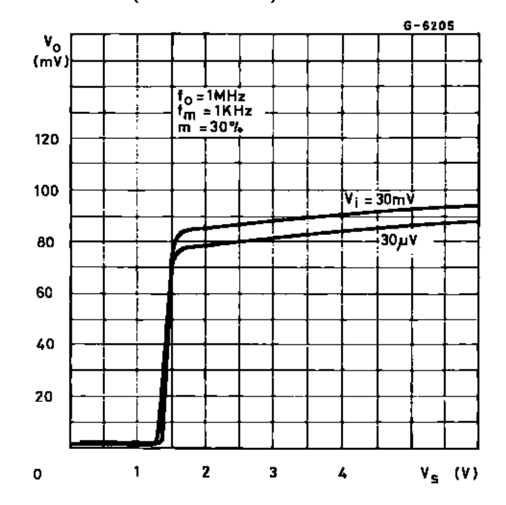


Figure 8 : Amplified AGC Voltage (Pin 4) versus Input Signal (AM section)

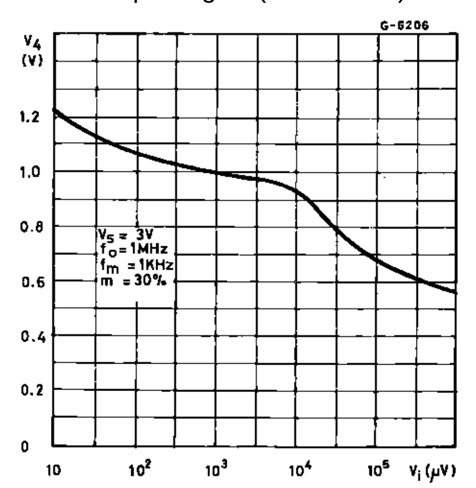


Figure 9 : Audio Output and Noise versus Input Signal (FM section) $V_S = 3V$

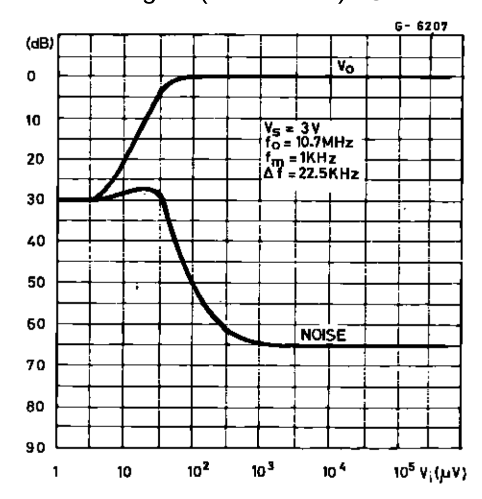


Figure 10 : Audio Output and Noise versus Input Signal (FM section) $V_S = 1.6V$

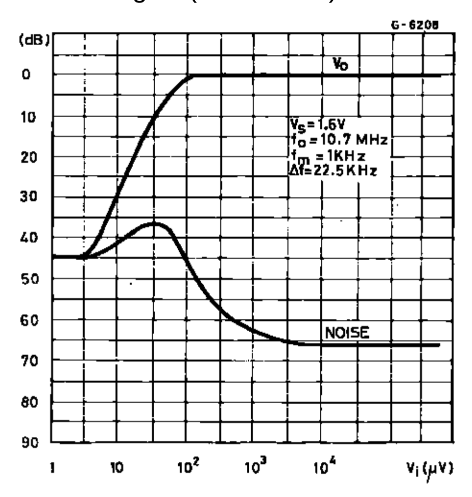


Figure 11 : Distortion versus Input Signal (FM section) $V_S = 3V$

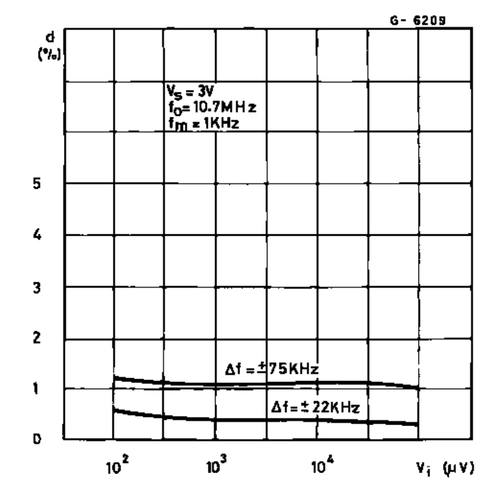


Figure 12 : Distortion versus Input Signal (FM section) $V_S = 1.6V$

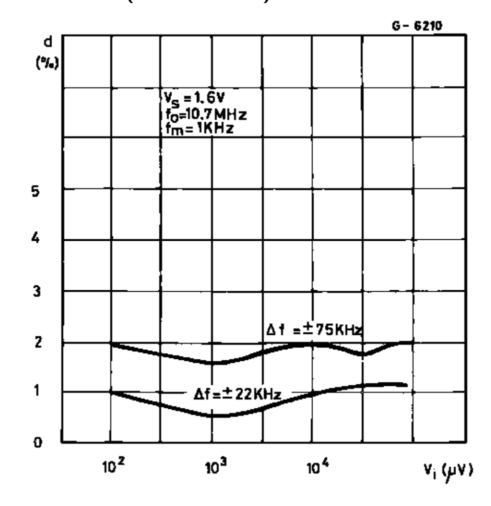


Figure 13 : Audio Output versus Supply Voltage (FM section)

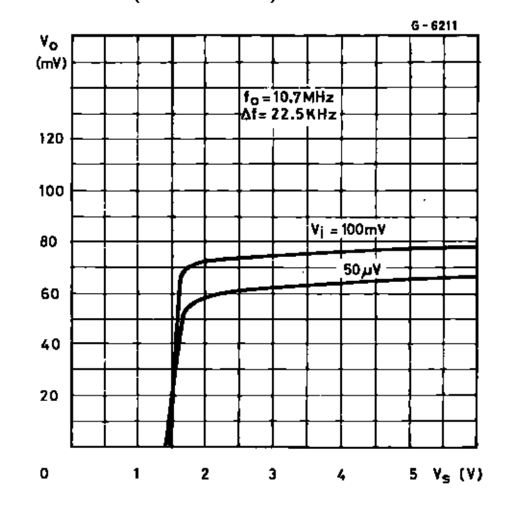


Figure 14 : Amplified AGC Voltage (Pin 4) versus Input Signal (FM section)

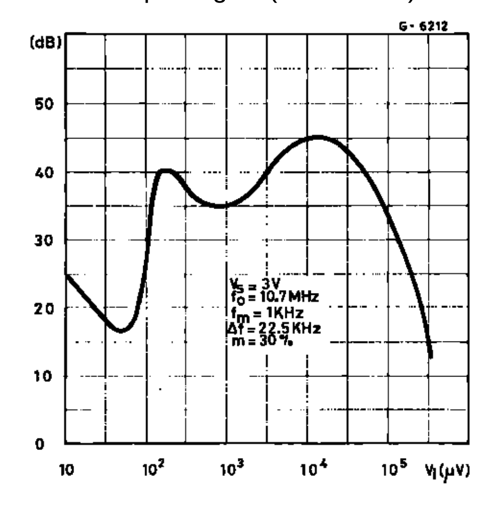


Figure 15 : DC Output Voltage (Pin 9) versus Supply Voltage (FM section)

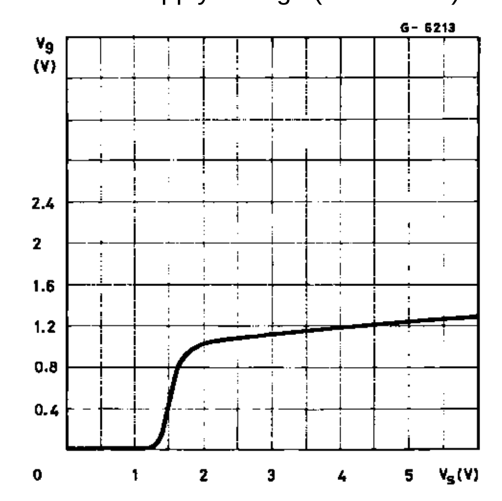


Figure 16 : AFC Output Voltage (Pin 9) versus Frequency Deviation (FM section)

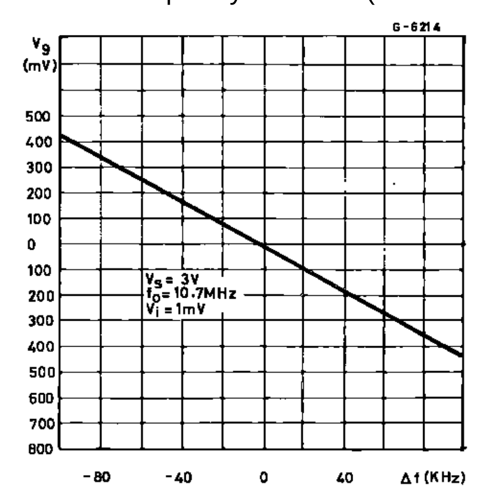
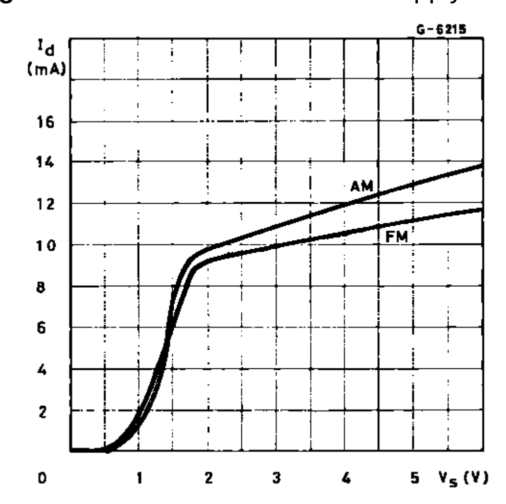


Figure 17 : Drain Current versus Supply Voltage



APPLICATION INFORMATION

TYPICAL PERFORMANCE OF THE RADIO RECEIVER OF FIGURE 18 (V_S = 3V, R_L = 32Ω)

Parameter		Test Conditions		Value	Unit
Wavebands	FM			87.5 to 108	MHz
	AM			510 to 1620	kHz
Sensitivity	FM	S/N = 26dB, Δf = 22.5kHz		3	µV
	AM	S/N = 6dB, m = 0.3		2	µV
	AM	S/N = 26dB, m = 0.3		10	µV
Distortion (f_m = 1kHz)	FM	P_O = 20mW, V_I = 100µV	Δf = 22.5kHz	0.5	%
			Δf = 75kHz	1.8	%
	AM		m = 0.3	1.1	%
Signal to Noise (f_m = 1kHz)	FM	P_O = 20mW, V_I = 100µV	Δf = 22.5kHz	60	dB
	AM		m = 0.3	45	dB
Amplitude Modulation Rejection	FM	V_I = 100µV, Δf = 22.5kHz, m = 0.3		40	dB
Quiescent Current				16	mA
Supply Voltage Range				1.6 to 3	V

APPLICATION INFORMATION

Figure 18 : Stereo AM/FM Miniradio

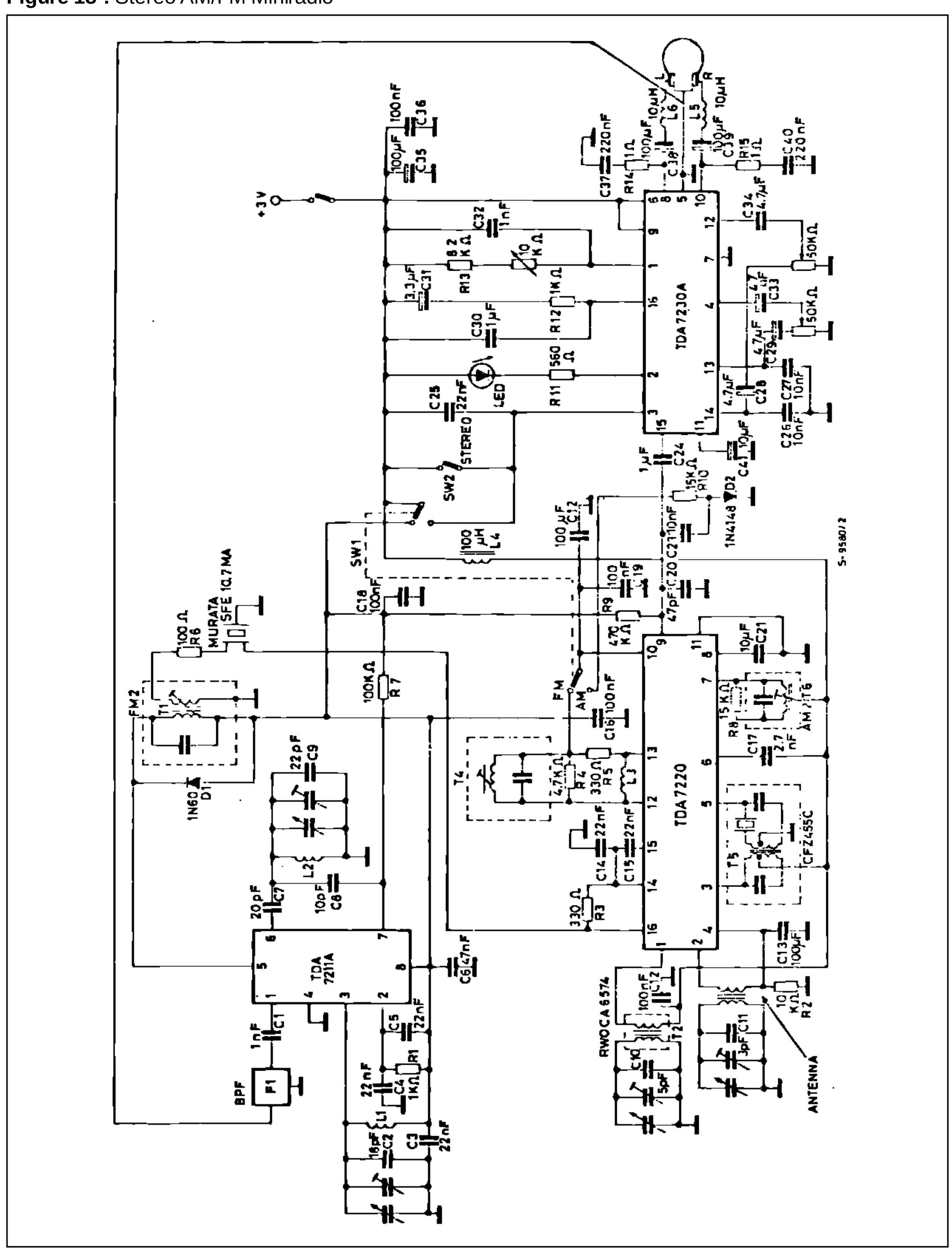
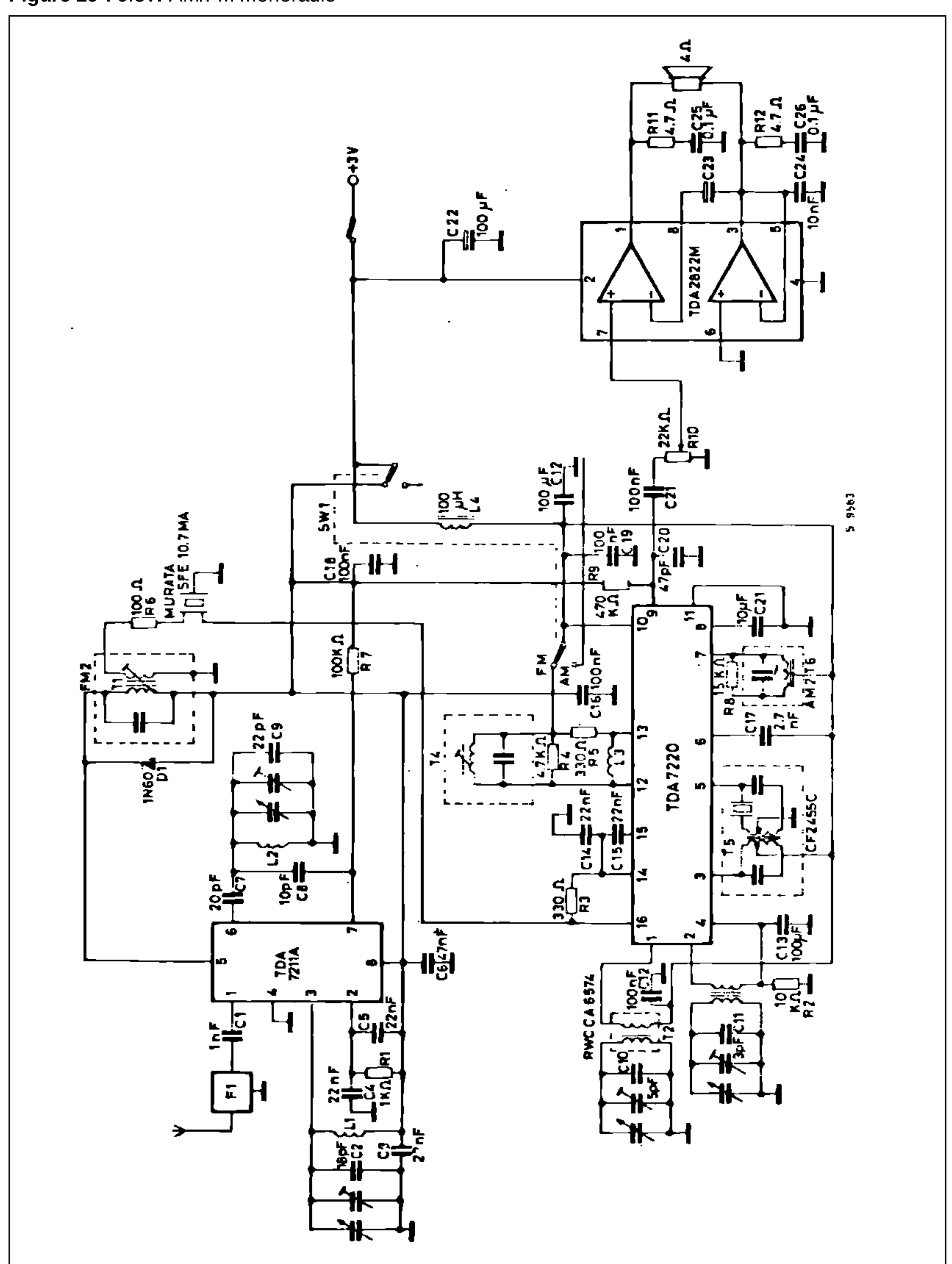
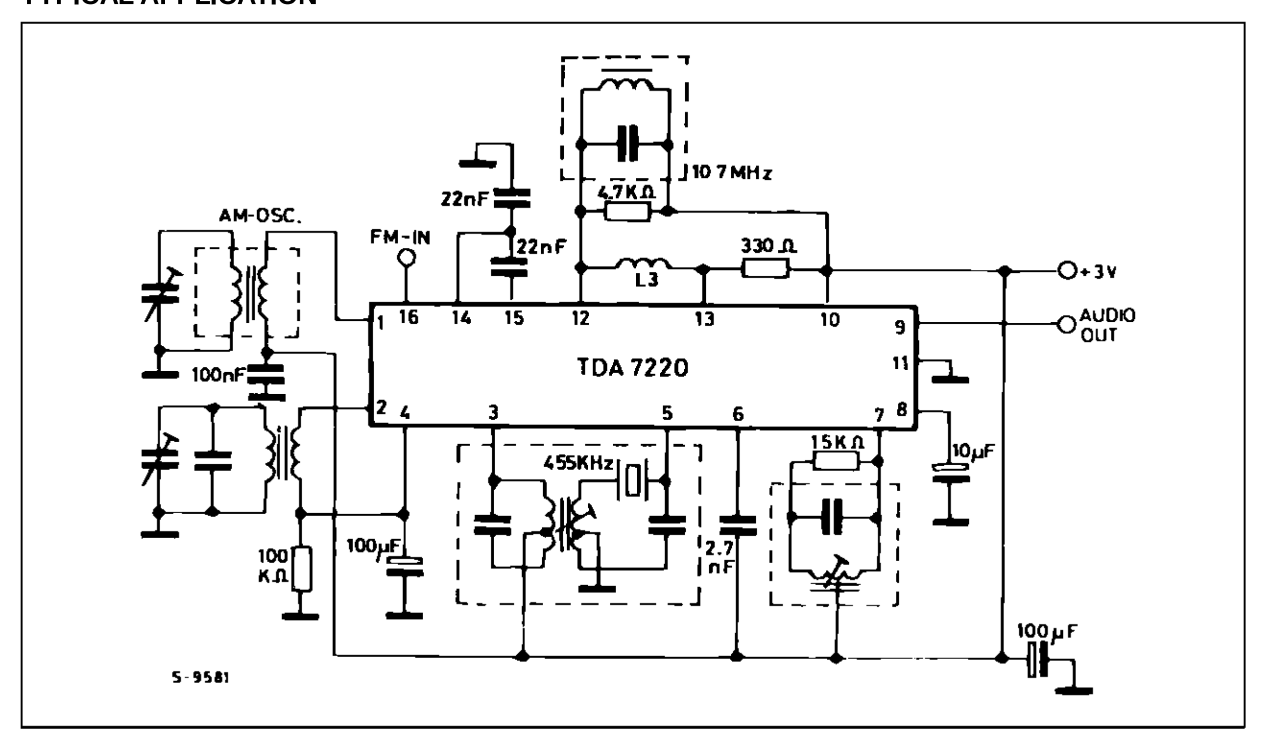


Figure 19 : 0.3W AM/FM Monoradio



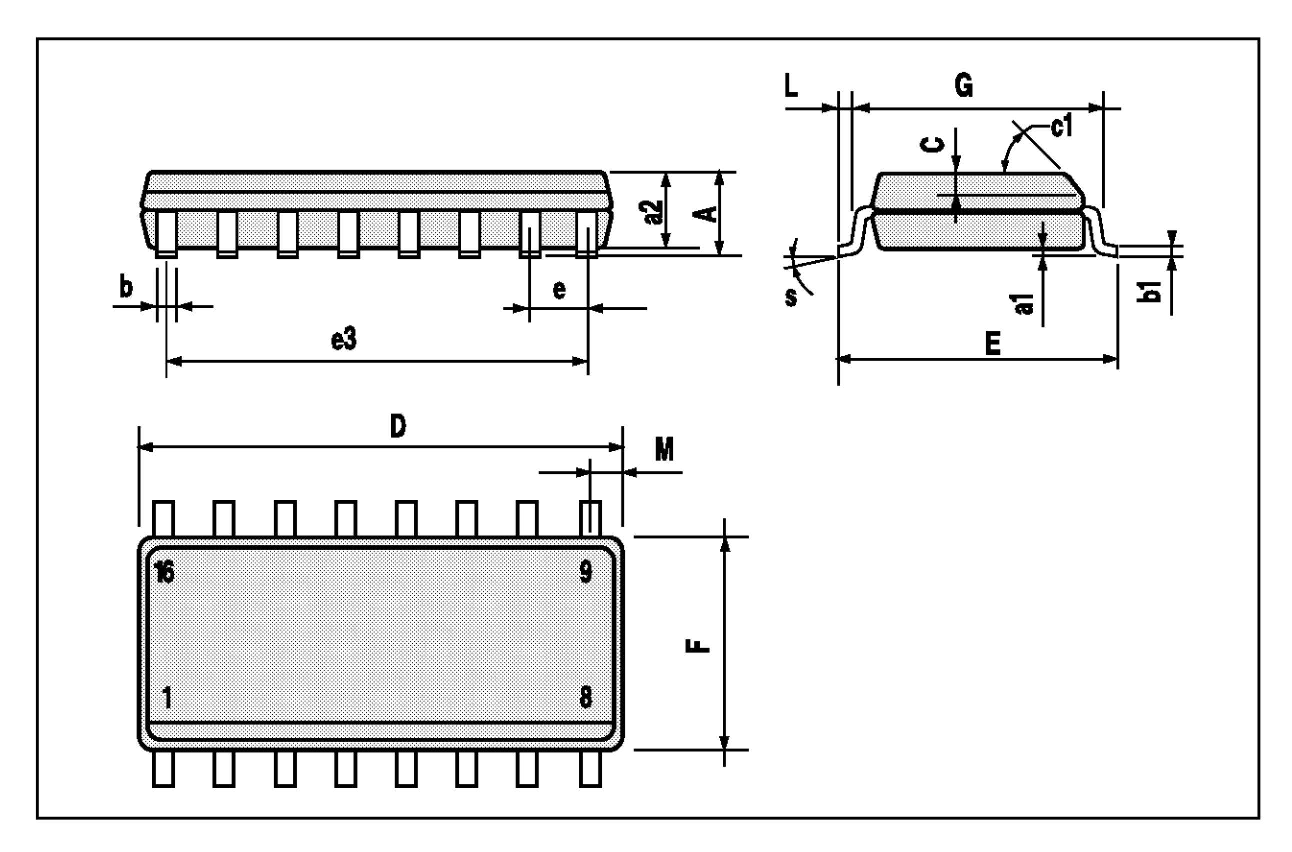
TYPICAL APPLICATION




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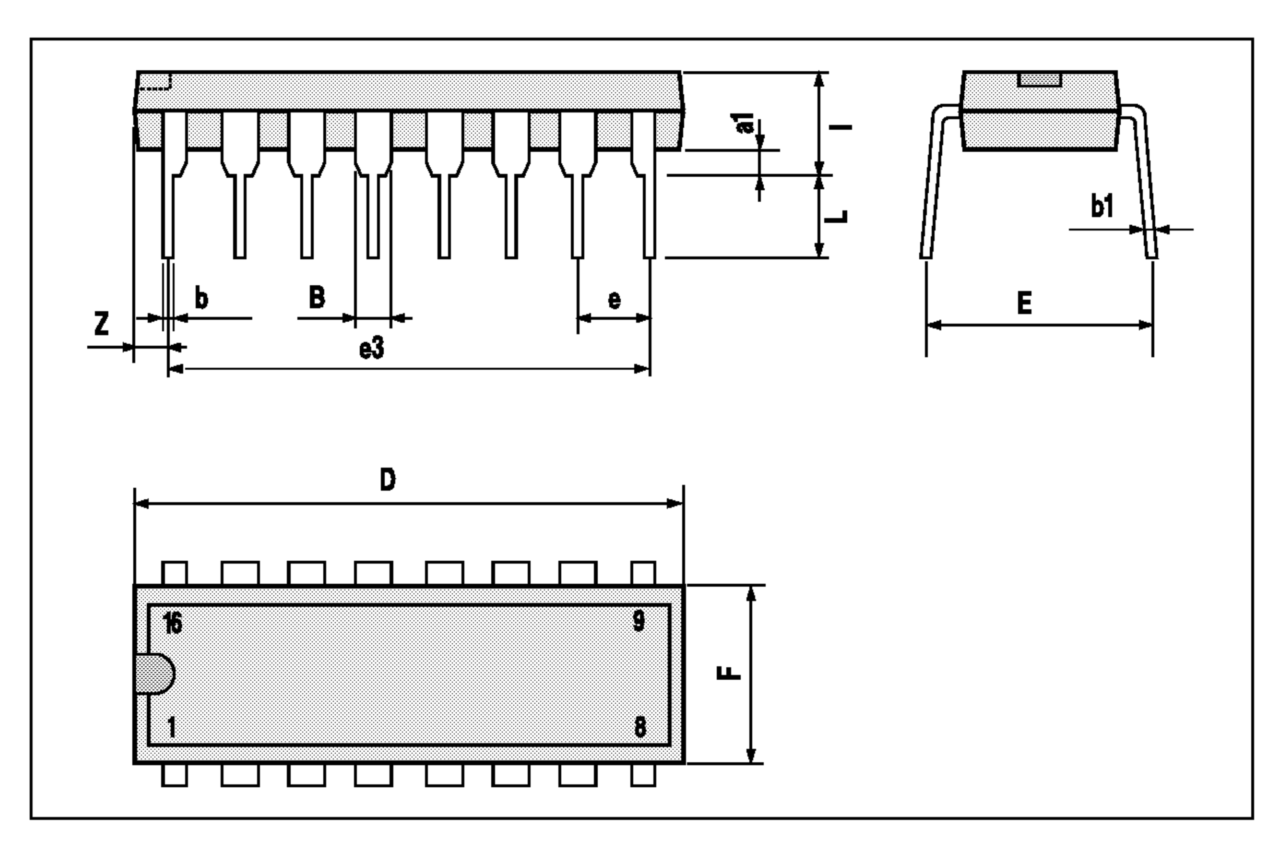
SO16 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45 (typ.)					
D	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.62			0.024
S	8 (max.)					



DIP16 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



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